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USING THE SEPARATION INDEX FOR IDENTIFYING THE DOMINANT ROLE IN AN ORGANIZATION: A CASE OF PUBLICATIONS IN ORGANIZATIONAL INNOVATION

Chia-Jung Lee
Department of Chinese Medicine, Chi-Mei Medical Center, Taiwan

Willy Chou*
Department of physical medicine and rehabilitation,
Liuying Chi Mei hospital, Tainan, Taiwan
*Corresponding Author - renin9999@gmail.com

Tsair-Wei Chien
Department of Medical Research, Chi Mei Medical center, Tainan, Taiwan

Yu-Tsen Yeh
Medical School, St. George's, University of London, London, United Kingdom

Tung-Hui Jen*
Department of Chinese Medicine, Chi-Mei Medical Center, Taiwan
Bachelor Program of Senior Services,
Southern Taiwan University of Science and Technology,
*Corresponding Author - renin9999@gmail.com

Abstract

The study aimed to propose an index (called separation index) that can objectively determine the dominant role in an organization. We simulated data to verify the separation index that can be viable in use for determining the dominant one who has the

absolute advantage in a group. We selected 3,751 abstracts and the author affiliated regions on January 2, 2019, from Pubmed Central (PMC) based on the topic of organizational innovation from 2013 to 2017. A novel hx-index incorporating the x-index was proposed for improving the h-index used in academics. Two topics were addressed on: (1) which dominant nations were in the field using hx-indexes and the choropleth map to present, and (2) what are the features of the dominant nations toward either the citation-oriented or the productivity-oriented using the Kano model to display. We programmed Microsoft Excel VBA routines to arrange the data. Visual dashboards were created for displaying the results on Google Maps. We observed that (1) the top three nations that conducted research on organizational innovation with excellent hx-indexes were the US (20.5), the UK (11.5), and Canada (10.5); (2) the US with the reliability power=0.73 yielded by the separation index is the dominant nation in the field of organizational innovation. The US presents the feature of productivity-oriented research achievements. The separation index is useful and viable in verifying the dominant role in an organization. The implementation and application are worthy of further studies in the future.

Keywords: hx-index, separation index, organizational innovation, Kano model

Introduction

We often look for a measure that can verify the size of firms in relation to the industry that can indicate the strength of competition. The Herfindahl index (also known as Herfindahl–Hirschman Index, HHI, or sometimes HHI-score) is the one named after economists Orris C. Herfindahl and Albert O. Hirschman (Hirschman, 1958). The HHI is an economic concept widely applied in competition law, antitrust and also technology management (Catherine & Alan, 2004).

The HHI is defined as the sum of the squares of the market shares of the firms (i.e., $H=\sum_{i=1}^{n} s_i^2$, where the number in the industry) (n, sometimes limited to the 50 largest firms). The market (s) shares are expressed as fractions (e.g., H= 0.5 = 0.5*0.5+0.5*0.5 for two equal- size companies). An H above 0.25 indicates a high concentration. Otherwise, a small index indicates a competitive industry with no dominant players in the industry. The problem is that only the dominant player (i.e., the 100% monopoly) is concerned. Like we investigate one questionnaire forming a unidimensional construct with Eigenvalues (Chien 2012), the dimension coefficient (DC) is obtained

by the top three eigenvalues (λi) with the formula (=[(λ1/λ2)/ (λ2/λ3)]/ [1+[(λ1/λ2)/ (λ2/λ3)]]) and criterion (≥0.70), where λi stands for the number of Eigenvalues in descending order (Lord, 1980; Divgi, 1980), The ratio (=[(λ1/λ2)/ (λ2/λ3)]) is named as separation index (SI) to define the dominant one in an organization. Whether the SI can objectively determine the dominant role in an organization is required for an investigation.

Thus, this study aimed to illustrate the SI and then propose a hx-index for improving the h-index (Hirsch, 2005) in bibliometric analyses and investigate the following two topics: (1) which dominant nations were in the field using hx-indexes and the choropleth map to present, and (2) what are the features of the dominant nations toward either the citation- oriented or the productivity-oriented using the Kano model to display.

Methods

Data Sources

We programmed Microsoft Excel visual basic for applications' (VBA) modules to extract abstracts and their coauthors' names as well as the countries/regions of authors' affiliations for each article on January 2, 2019, published in the PubMed Central (PMC) from 2013 to 2017, based on organizational innovation. Only abstracts related to organizational innovation and labeled with Journal articles were included. Other abstracts like those labeled with Published Erratum, Editorial, or without author nation name were excluded from this study. A total of 3,751 eligible abstracts were obtained from PMC.

The Separation Index

We define the separation index as the formula (=sqrt ([(λ1/λ2)/ (λ2/λ3)])) (Chien 2012), where λi represents the squared values from top one to three in descending order. The ratio (=[(λ1/λ2)/ (λ2/λ3)]/[1+ [(λ1/λ2)/ (λ2/λ3)]], named Fp for short) from 0 to 1.0 is the strength of concentration to the first one, the higher means the stronger extent to which the monopoly is forward to. The cutting point is set at 0.7 (Chien, 2012), similar to the Cronbach Alpha in classical test theory.

The formula of the Fp can be divided into two parts: F1= (λ1/λ2) and F2= (λ2/λ3) as F-value (=the sum of squares (SS) ÷ the error) in the analysis of variance (ANOVA). The reliability (Rp) equals F1/ (F1+F2) (= 1-F2/ (F1+F2) = Fp/ (1+Fp)).For in-

stance, the first firm has the market sale (=846), followed by the second (=117) and the third (=62). The SI equals 3.83 (=sqrt (7.23/1.88)) to respond to the Rp=0.94 (=14.68/ (1+14.68).

If the trigonometric function is applied to the computation for the Rp, we plot four scenarios in Figure 1. From which, we can see that the higher angle, counterclockwise form the right to the left, yields lower the Rp value. The Rp equals 0.5 if the angle is 180.

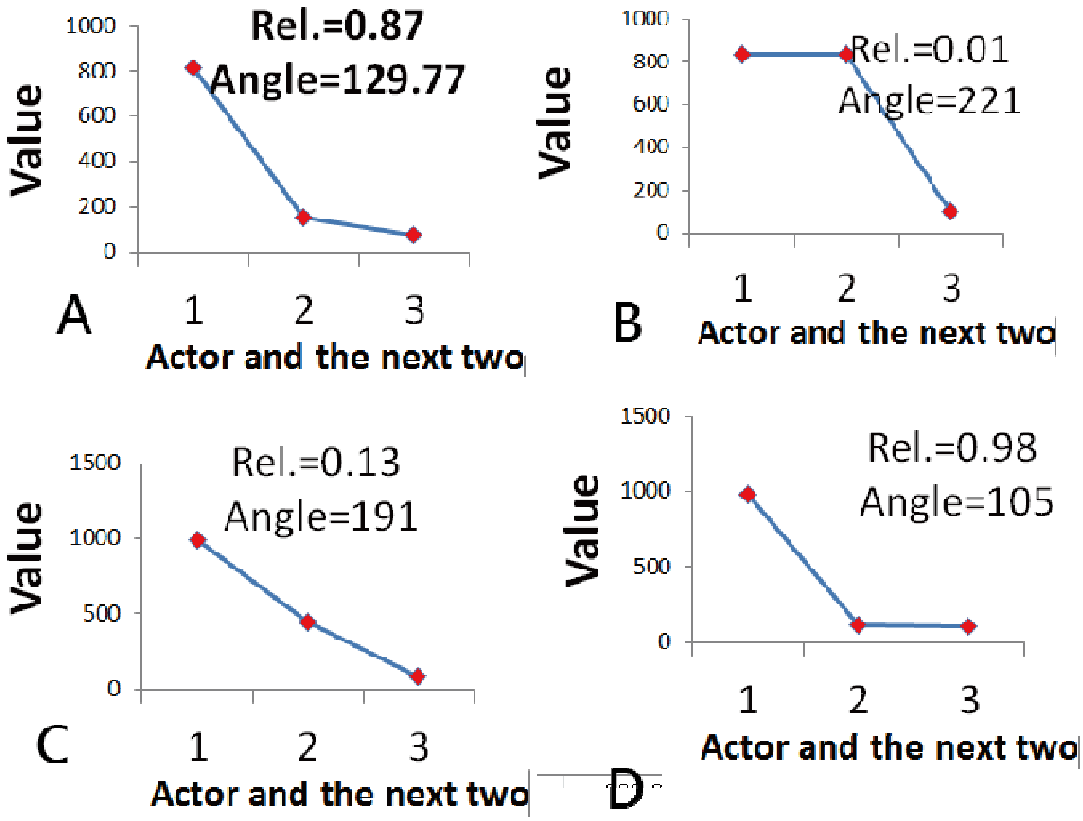

Figure 1. Four Scenarios For Interpreting The Meaning Of The Separation Index

The Novel hx-index

As to make the h-index have higher discrimination power with decimal values (Huang & Chi, 2010), the hx-index is defined as the formula (1), where rh is the ratio (=citations/ publications at the x-core on the x-index) (Huang, Wu & Chien, 2019).

Hx-index = h + rh/ (1+ rh), (1)

The Choropleth Map and the Kano Diagram

Choropleth maps (CM) have been applied to the use in the disparities in health outcomes across areas in many disciplines (Chien, et al., 2019). There are certain disadvantages that can be experienced when using them. For example, the dominant nations are hard to discriminate or define Choropleth. To resolve the problem, the Kano diagram (Kano, et al.,1984) and the separation index might be useful to complement CMs for a better interpretation of the disparities in outcomes across countries/areas.

The Kano Model is based on a theory of product development and customer satisfaction developed in 1984 by Professor Noriaki Kano (Kano, et al.,1984), who classifies products or items into three main categories of quality: basic requirement, one- dimensional quality, and exciting feature. These are diagrammed according to the satisfaction perceived by customers on Axis Y and the effort achieved by providers on Axis X.

The Rp for each entity can be applied to examine the dominant extent that needs one coefficient to define. The bar chart was used for demonstrating the phenomenon in which we are interest for determining the dominance using the Rp and the angle in relation to the research achievements for each nation.

Creating Dashboards on Google Maps

Author-made modules showed the research achievements on organization innovation for each country in Excel (Microsoft Corp). We created pages of HTML used for Google Maps. All the relevant information on the entities (i.e., countries or areas) can be linked to dashboards on Google Maps.

Results

The dominant nations on organizational innovation were the US (20.5), the UK (11.5), and Canada (10.5), see Figure 2. The US has the feature of the productivity-oriented because of the red bubble at the right-bottom corner. The UK and Canada are also classified as productivity in red bubbles. The two of Netherlands and Sweden located at the left-top side with green bubbles, indicating the feature of the citation- oriented in research achievements, see Figure 3.

In Figure 4, we can see that the US is the only nation with the Rp>0.70 and the least angle determining the

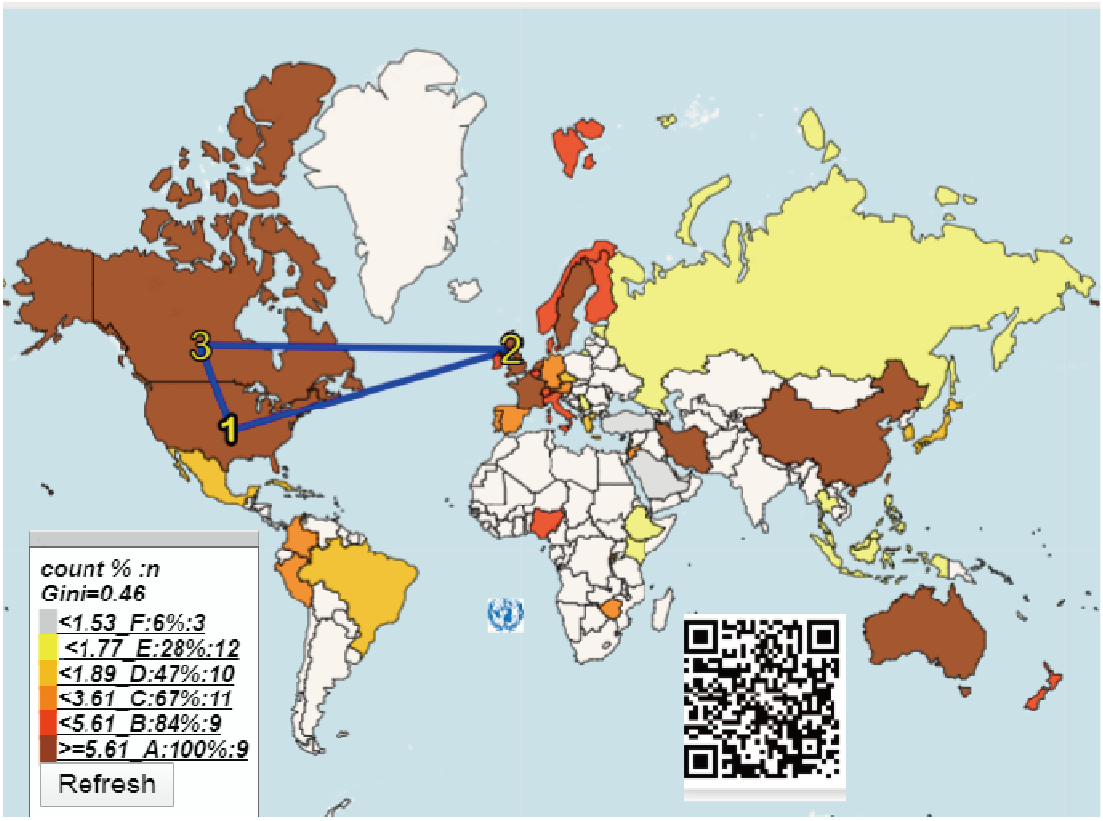

Figure 2. The dominant nations on organizational innovation using hx-index and choropleth map to display

extent to which the dominant power is forward.

Discussions and Conclusion

We observed that (1) the top three nations that conducted research on organizational innovation with excellent hx-indexes were the US (20.5), the UK (11.5), and Canada (10.5); (2) the US with the reliability power=0.73 yielded by the separation index is the dominant nation in the field of organizational innovation in the past.

Although the h-index (Hirsch, 2005) being a popular author-level metric that can simultaneously measure both the productivity and citation impact of the publications of a scientist, one of its shortcomings is less discriminative power (Huang & Chi, 2010) due to many with identical value (i.e., in an integer form). Many concepts of bibliometrics have already been proposed in the past (Fenner, et al., 2018; Zhang, 2009/2013), but we have not seen any that can be successfully applied to the scientific disciplines in use.

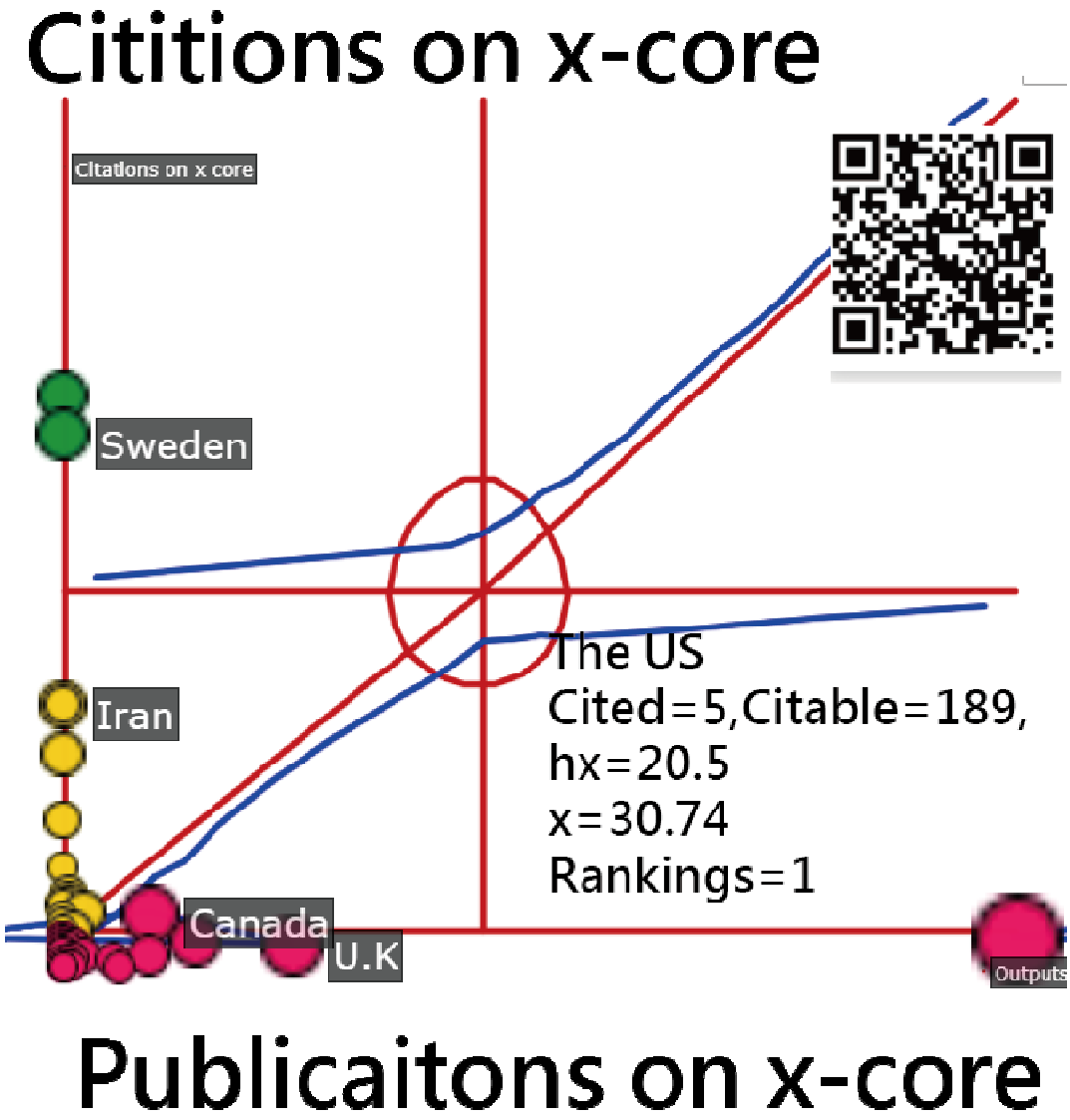

Figure 3. The research achievements on organizational innovation using hx-index and the Kano model to display

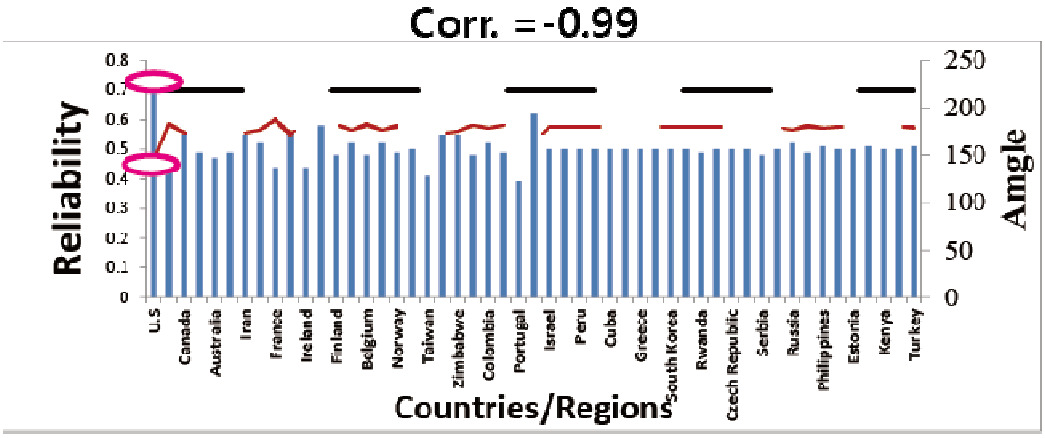

Figure 4. The Dominant Nation On Organizational Innovation Is The US

We applied the hx-index to effectively improve h-index with high discriminative power for evaluating research achievements as we did in this study, which is recommended applying hx-index to other fields in the discernible future.

We demonstrated the usage of the hx-index on organizational innovation in academics, particularly on articles in PMC, using an author-weighted scheme (Chien, Wang & Lai, 2019) for quantifying contributions among nations driven by the authors' contributions and credits in an article byline, which was rarely seen in the literature before. Both dashboards were created using Google Maps that can be also applied to other fields in the future.

The bibliometric indices are dependent on both quantity (i.e., the number of publications) and the quality (i.e., the number of articles being cited), which is suitable for use in the field investigating the most cited author-affiliated countries/regions as we did in this study. In Figures 3 and 4, it is easy to see the features of nations related to the information not shown on the choropleth map in Figure 2.

Similarly, the hx-index using the concept of x-index (Fenner, et al., 2018) on organizational innovation in Figure 3 will be complemental to h-index even if the bubbles are sized by the h-index on the Kano diagarm. The bubble locations on the Kano diagram are discriminable more than other types of visual representations in the past. The most worth-noting feature is the separation index proposed in this study. In many situations in daily livings, we encounter the need for dis-

criminating against the dominant role in an organization or a group. For instance, we see the top three players in the 2019 World Athletics Championships (Men's decathlon) with the scores of 9126, 9045, and 8711. The Rp is equal to 0.48 (<0.70), indicating the top one player is not the dominant role and implying the second one closely follows the top one.

The second feature is the choropleth map and the Kano model being sophisticatedly applied to this study as we did in the previous study (Lin, Chou, Chou, Chien, 2019).

The reason we applied hx-index in this study is the strength of the index in practice and with the advantage of the h-index simple and easy to interpret. According to the illustration in the study of Fenner and his colleagues (2018), the feature of the x-index can truly extend the author-level research achievement in academics.

Although findings are based on the above analysis, there are still several potential limitations that may encourage further research efforts. First, all data were extracted from the PMC. There might be some biases of the author's names with affiliated countries/regions because of some blanks in the article, which will affect the result of analysis by the accuracy of the indexing affiliated countries/regions.

Second, the proposed separation index has several limitations, such as the last two entities would be not involved in the computation due to the last three who need the next two to compute the SI in descending order. The easy way to examine the last two is using the F2/F1 indicating the inversed result (e.g., (F1/F2)/ (1+ (F1/F2))=1- (F2/F1)/ (1+ (F2/F1)) in nature.

Third, the data extracted from *PMC* cannot be generalized to other major citation databases—such as the Scientific Citation Index (SCI; Thomson Reuters, New York, NY, USA) and Scopus (Elsevier, Amsterdam, The Netherlands). Such as the most cited authors are determined by the paper selections on Pubmed.

In conclusion, the separation index is useful and viable in verifying the dominant role in an organization or a group. The implementation and application are worthy of further study in the future.

References

Catherine, L.-H., Alan, P. (2004). Inventive Concentration: An Analy-

sis of Fuel Cell Patents. Science and Public Policy, 31:1, 15-25.

Chien, T.W. (2012). Cronbach's Alpha with the Dimension Coefficient to Jointly Assess a Scale's Quality. Rasch Measurement Transactions, 26:3, 1379

Chien, T.W., Wang, H.Y., Hsu, C.F., Kuo, S.C. (2019). Choropleth map legend design for visualizing the most influential areas in article citation disparities: A bibliometric study.Medicine (Baltimore), 98: 41, e1752

Chien, T.W., Wang, H.Y., Lai. (2019). Applying an Author-Weighted Scheme to Identify the Most Influential Countries in Research Achievements on Skin Cancer: Observational Study.JMIR Dermatol., 2 (1),e11015

Divgi, D.R. (1980). Dimensionality of binary items: Use of a mixed model. Paper presented at the annual meeting of the National Council on Measurement in Education. Boston, MA.

Fenner, T., Harris, M., Levene, M., Bar-Ilan, J. (2018). A novel bibliometric index with a simple geometric interpretation. PLoS One,13 (7), e0200098.

Hirsch, J. E. (2005). An index to quantify an individual's scientific research output. Proceedings of the National academy of Sciences, 102 (46), 16569–16572.

Hirschman, A. O. (1958) The Strategy of Economic Development. Yale University Press.

Huang, M.H., Chi, P.S. (2010). A comparative analysis of the application of h-index, g-index, and a-index in institutional-level research evaluation. Journal of Library and Information Studies, 8:2,1-10.

Huang, T.L., Wu, J.H., Chien, T.W. (2019). Exploring the relationship between medical organization innovaiton and other medicl subjects using social network analysis. The International Journal of Organizational Innovation,12:1, 45-54.

Kano, N., Seraku, N., Takahashi, F., Tsuji, S. (1984). Attractive Quality and Must-Be Quality. Journal of the Japanese Society for Quality Control , 41, 39-48.

Lin, C.H., Chou, P.H., Chou, W., Chien, T.W. (2019).Using the Kano model to display the most cited authors and affiliated countries in schizophrenia research.Schizophr Res., pii: S0920-9964 (19)30493-1.

Lord, F.M. (1980). Applications of item response theory to practical testing problems. Hillside, NJ: Erlbaum.

Zhang, C. T. (2009). The e-index, complementing the h-index for excess citations. PLoS One, 4 (5),e5429.

Zhang, C. T. (2013). The h'-index, effectively improving the h-index based on the citation distribution. PloS one, 8 (4), e59912.